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ABSTRACT

This staff development program was directed toward the implementation of a new, hands-on elementary science program. The primary focus was three-fold: (1) to train teachers to implement a new program; (2) to increase the time devoted to science instruction; and (3) to provide teachers with additional science content background. This approach significantly altered teacher behaviors both in the amount and kinds of science instruction they imparted to students. Data indicated that as a result of this staff development project, teachers implemented the new program at a rate and depth that far exceeded what is customary based upon national studies. This document includes a program overview, a discussion of the assessment of the program, and a discussion of program outcomes. (Author/CW)

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THE CARROLL COUNTY ELEMENTARY SCIENCE PROGRAM: A HANDS ON APPROACH

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An AASA Staff Development Award Winning Program

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ABSTRACT

This staff development program was directed toward the implementation of a new, hands-on elementary science program. The primary focus was three fold: (1) to train teachers to implement a new program, (2) to increase the time devoted to science instruction, and (3) to provide teachers with additional science content background. Four key components were involved:

Summer grade level workshops where teachers undertook the activities they would be teaching. These were used as a vehicle to show teachers management strategies that could be employed in teaching hands-on science. For the first day the principle of "teachers teaching teachers" was employed to develop a more positive response and minimize negative feelings participants may have had about implementing a new program. Instruction on the second day was provided by a local college staff member with expertise in elementary science.

Follow-up workshops to resolve problems encountered in teaching the new program in addition to more content background for the topics at their grade level. Work was also undertaken in developing evaluation strategies appropriate for a process oriented approach.

Coaching which employed graduate assistants from a local university to work with implementing teachers and provide them with both feedback about instruction and assist teachers in implementation of the program.

Honors workshops in which exemplary teachers participated in a graduate course offered by a local college. Participants were provided training in all grade levels of the program. Follow-up workshops were subsequently provided for those individuals to assist them to become building resource people.

This approach significantly altered teacher behaviors both in the amount and kinds of science instruction they provided students. Data indicated that as a result of this staff development project, teachers implemented the new program at a rate and depth that far exceeded what is customary based upon national studies.

In "First Lessons", Secretary of Education Bennett called for a greater commitment to activity based science. "We need a revolution in elementary-school science. There is probably no other subject whose teaching is so at odds with its true nature....But as a "hands-on" adventure...taught by (a knowledgable) regular classroom teacher, it can sweep children up in the excitement of discovery...."

Repeated studies have, however, shown that elementary teachers devote little time to science instruction and that the existing science is poorly taught, most often consisting of textbook exercises. Research also finds that elementary teachers avoid hands-on, process oriented science instruction although it has been consistently found superior to text instruction and recommended by a number of national studies and, more recently, by the U. S. Department of Education.

In the public schools of Carroll County, Maryland, a staff development program was directed toward altering those traditional teacher behaviors during the implementation of a new, hands-on elementary science program built upon the development of science process skills. The focus of this training effort was three fold:

- to train teachers for implementation of a new program.
- to increase the amount of time devoted to science instruction.
- to provide teachers with science content background and methodologies required to teach a hands-on program.

SETTING

Carroll County is a rural school system consisting of approximately 20,000 students. Sixteen elementary schools typically house students in kindergarten through grade five. Schools in the system are both traditional, self-contained as well as open space facilities. Population distribution allows for students to attend the school in their neighborhood and follows a logical feeder school scheme from elementary to middle and high schools.

The county continues to experience growth and an ever-changing student population as youngsters move into the area from surrounding metropolitan school systems. Although the county does not rank highly in either per pupil expenditures or professional staffing ratios, it is consistently well above the state average in standardized test results.

The Carroll County Hands-On elementary science program associated with this staff development project is a newly implemented curriculum that emphasizes a hands-on approach to science. It is based upon locally developed materials that were designed around science process skills instead of concepts at each grade level. Successive grade levels are designed to employ both a greater number and a higher order of these processes. Since this is not a text program, all lessons are based upon hands-on activities contained in the teachers' guide. Subsequent lessons are intended to extend these experiences into other areas such as art, language arts, or math where other applications can be made.

This locally developed science program was implemented after a pilot study compared it with two commercially available text series. Forty teachers were randomly assigned to treatment groups and each piloted two of the programs. Although four of the five decision criteria strongly favored the selection of the local program, pilot teachers indicated that the ease of implementing it was less than with either of the other two ($p<.001$). They also reported that it required a much greater amount of preparation time ($p<.001$). The need for extensive staff development during the implementation of this program was most clearly defined by the perception of pilot teachers that, if adopted, the new program would not be easily implemented by the ordinary classroom teacher ($p<.001$). Consequently, a large teacher training effort was designed to accompany the implementation of this elementary science program and to provide teachers with the skills necessary to teach it. More importantly, it was intended to alter teacher attitudes toward teaching science.

The elementary science program associated with this project was later selected as one of 13 national exemplar or model programs by the National Science Teachers Association in the "Search For Excellence In Science Education". More recently, it was approved for inclusion in the National Diffusion Network (NDN). A proposal was also funded by the National Science Foundation (NSF) to conduct an Honors Workshop in conjunction with the implementation of this science program which, in part, provided a basis for this staff development program.

STAFF DEVELOPMENT OVERVIEW

Implementation of this elementary science program involved a comprehensive staff training program which focused upon both instructional strategies and increased content background for teachers. This staff development project had several primary goals:

- to provide elementary teachers with the knowledge, skills and attitudes needed to implement a hands-on, process oriented elementary science curriculum.
- to increase the amount of time elementary teachers devote to science instruction.
- to provide elementary teachers with additional science content background.
- to assist teachers in evaluating student progress in a process oriented, rather than just a conceptually oriented, manner.

To best facilitate this given the fairly large numbers of teachers to be involved, implementation of the new program was phased in over a two year period with about half of the elementary schools involved in each of those years. Consequently all aspects of this staff development program as described were repeated and carried out twice.

Teachers were paid to attend a two day workshop in the summer where they, themselves, undertook nearly all the activities they would be teaching youngsters. Participants were brought together by grade level so that all activities completed could be directly related to what they would be doing in the classroom. These lessons were used as a vehicle to show teachers the management strategies to be used in teaching a hands-on science approach. The first day of instruction was provided by two teacher trainers for that grade level who had been involved in the development and/or piloting of the new program. To prepare these individuals, an extensive, one day planning session was held in advance of the time they would be working with colleagues. The principle of "*teachers teaching teachers* " was employed to develop a more positive staff response and to minimize the negative feelings many participants had about implementing a new program. Instruction on the second day was provided by an outside consultant, a teacher-education professor from a nearby college who had considerable expertise in teaching elementary science. The purpose of these pre-implementation workshops was to familiarize teachers with the new program while at the same time giving them the additional science content and instructional methodologies to teach it most successfully.

After nine weeks, teachers were brought together by grade level for a one day follow-up workshop to resolve problems encountered in teaching the new program. This gave teachers the opportunity to deal with problems they might be having, gain from others successes and share ideas. Teachers were also provided additional content background for the science concepts included at their grade level. Work was done in developing evaluation strategies appropriate for use in the process oriented approach. A second follow-up workshop was held in April to further resolve implementation problems.

Over a two year period, four graduate students from the University of Maryland were employed to work as coaches with implementing teachers. Their primary role was to provide, outside the formal evaluation procedures, feedback to teachers about how they were executing strategies provided in the training program. They also assisted teachers in planning and developing science lessons, team taught with teachers and, in essence, provided whatever help necessary to implement the program short of teaching the lesson for the teacher.

Over a two year period, forty-four exemplar teachers participated in a two week graduate Honors Workshop offered by Hood College. Participants were provided training in all grade levels of the program and given advanced science content related to those topics. Three times during the subsequent school year participants were brought together for day-long follow-up workshops where they were again provided science content and were involved in curriculum decisions related to the program. These highly trained individuals then served as building resource people who could assist others. The demand for participation in this program has been so great that the school system has already funded a repeat of that graduate level course for a third time and has made a commitment for a fourth offering.

This project was coordinated at the local level by the county science supervisor and an elementary supervisor. Their role was to plan and implement the project as well as to provide leadership and budgetary support for the program. They were also directly involved in working with teacher participants in all aspects of this training program.

This project is notable in that it was a cooperative effort between the local school system, the Maryland State Department of Education, Hood College and the University of Maryland. All four institutions were involved in this project prior to receiving the NSF grant, but had formalized subcontracts as a part of that funding. Teacher training and the graduate Honors Workshop course were conducted through the Hood College staff. The previous work they had done with teachers in other school systems and around the state was crucial in assisting teachers to more readily and successfully implement a new curriculum in their classroom. Under a contract with the University of Maryland, graduate students who served as teacher coaches were provided to the local school system to assist teachers having difficulties in teaching a program for the first time.

ASSESSMENT

To assess the effectiveness of this staff development effort, a study was undertaken to determine how readily teachers were able to successfully implement the new hands-on elementary science program. Included as subjects were teachers and students in the seven schools which implemented the program during the first year of the two year phase in plan. Because of teaming arrangements within a grade level, not all teachers taught science although all students received science instruction. Only those teaching science were included in the study. This resulted in 82 certified teachers best characterized by an average of 15.8 years experience , 73% of whom had a masters degree and 93% were female. The 2408 student subjects were enrolled in the classes of the sampled teachers. Nearly equal numbers of sexes were present and 33% were in open-space classrooms.

Four instruments were employed: 1) The "Survey of Teaching Science" teacher attitude questionnaire, 2) the "Stages of Concern About The Innovation Questionnaire", 3) the "Levels of Use of the Innovation", and 4) a "Student Survey of Science" attitude assessment. The "Survey of Teaching Science" was a locally developed teacher attitude questionnaire consisting of 20 five-item, Likert-type questions with a 0.92 Alpha Coefficient index of reliability. The "Stages of Concern" and "Levels of Use" are two

dimensions of the Concerns-Based Adoption Model (CBAM). These instruments were designed to measure the success of implementing an innovation and the extent to which it alters teacher behavior. The "Levels of Use" is a highly structured interview instrument which results in the rating of the teacher user as being at one of the following eight levels of use of the program: 1) non-use, 2) orientation, 3) preparation, 4) mechanical, 5) routine, 6) refinement, 7) integration, or 8) renewal.

OUTCOMES

A variety of information indicates that instruction has changed as a result of this science program and the training associated with it. Teachers report that science learning more emphasizes a direct hands-on approach ($p<.001$) and provides for the greater inclusion of science processes ($p<.001$) while fostering greater discovery and experimentation by students ($p<.001$).

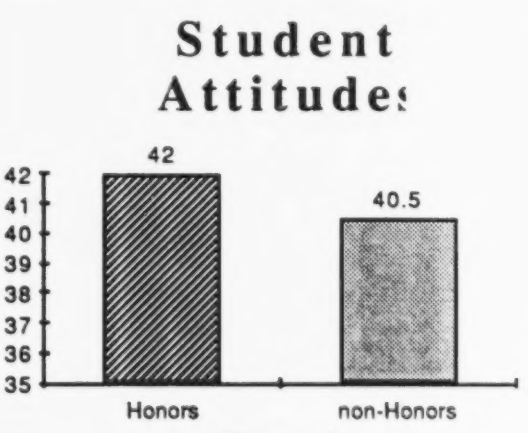

Figure 1

As a result, teachers perceive students more motivated ($p<.001$) which more often caused them to go beyond the assignedactivity and try ideas on their own ($p<.005$). For example, last year 51% of all elementary students in the system requested copies of a voluntary "Summer Science Fun" package of activities to work on over their vacation months. In addition, data show that students with this hands-on elementary science approach repeatedly score about 41 points on a 45 point instrument assessing attitudes toward learning science. Pupils of Honors Workshop participants exhibit higher attitude scores than do youngsters of teachers who have not participated ($p<.05$) (Figure 1) . Overall, students rank science as their favorite subject at a rate that is 4.5 times greater than found in the National Assessment of Educational Programs (NAEP). More specifically, those youngsters of teachers who had participated in the Honors Workshop chose science as their favorite subject with a greater frequency than did the students of their counterparts ($p<.005$).

Important changes have also occurred in teacher behaviors and attitudes resulting in a greater program implementation than typically found by research. Teachers reported they were more motivated to teach the science program ($p<.005$), derived more satisfaction ($p<.001$), and devoted more time to teaching science ($p<.001$). Using the Concerns Based Adoption Model, the extent teachers implemented the new program was evaluated. Levels of Use procedures indicated only 27% at the Mechanical Stage with 51% at the Routine Stage and 22% at the Refinement Stage. This is most significant since it normally takes users up to three years to move beyond the Mechanical Stage. Implementation increases significantly after participating in the Honors Workshop ($p<.001$): Mechanical, 0%; Routine, 31%; and Refinement, 69% (Figure 2) .

Also, staff development participants have voluntarily sought additional science coursework through a Hood College course which provides additional content and methodologies associated with the program implemented. Of the teachers in this program, 46% have applied for this course although by the fall semester only 38% of the teachers could be accomodated. Teacher demand will dictate that it continue to be offered several more times in the future.

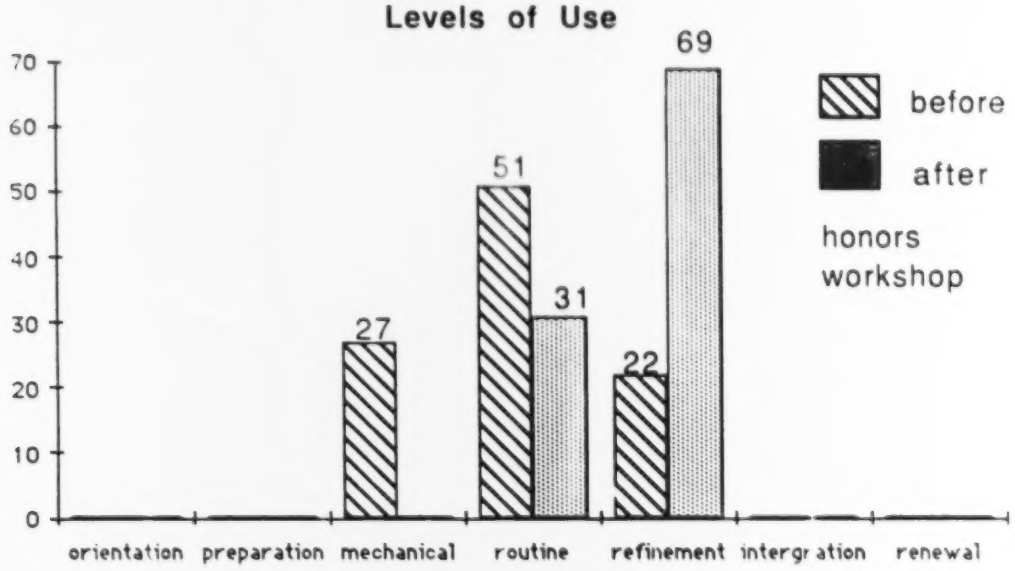

Figure 2

Teacher attitudes also showed a significant increase as a result of this staff development project. Prior to the end of the first year of implementing the new elementary program, teacher attitudes were evaluated using an instrument which assessed attitudes toward the teaching of science. Attitude scores for the group of teachers who subsequently participated in the Honors Workshop increased ($p<.05$) by the end of the next school year. No such increases were discernible for those teachers who had not been involved in the workshop.

SUMMARY

It is evident that this staff development program has provided that kind of support and teacher involvement and has had a significant impact upon teacher behaviors as they have attempted to implement a new elementary science program. As a result of the training and support provided, teachers are more positive about the teaching of science which has positively impacted upon student attitudes. Just as importantly, the data indicate that the training provided teachers has facilitated the implementation of the program more rapidly and to a greater degree than research suggests is customary.